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Students' Profile Score in Perceptual Reasoning Index (PRI) and Working Memory Index (WMI) for Intelligence Test

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Abstract

This study examines students' profile score in the Perceptual Reasoning Index (PRI) and Working Memory Index (WMI) based on gender intelligence test. Instrument created to measure intelligences is known as UKM2. This instrument consists of 370 dichotomous and partial credit items which are divided into four indexes, Perceptual Reasoning Index (PRI), Working Memory Index (WMI), Processing Speed Index (PSI) and Verbal Comprehension Index (VCI). This survey was administered to 497 bachelor degree students at one of Malaysian institutes of higher learning. Research findings indicate that the female students' mean scores in the PRI and WMI is higher than male students.

Keywords: Perceptual reasoning index (PRI); Working memory index (WMI); Processing speed index (PSI); Verbal comprehension index (VCI); UKM 2 intelligence test

1. Introduction

Intelligence refers to the ability to understand what people see, experience, and to be heard (Rosadah, Noriah & Melor, 2008; Siti Rahayah, 2008; Sidek, 2005). Intelligence can be classified as a Mental, Emotional and Spiritual Intelligence (Siti Rahayah, 2008). *Intelligence Quotient* (IQ) or degree of intelligence is closely related to the level of competence, capability and ability of individuals in nature (Siti Rahayah, 2008; Sidek, 2005). The term was first introduced by Wilhelm Stern in 1912 (Clark, 2008) to represent the scores in intelligence tests in which it is obtained by dividing mental age by chronological age and multiplied by 100 (Clark, 2008; Rahayah, 2008; Rosadah et al. 2008; Sidek, 2005).

There are varieties of tests designed by psychologists to measure and distinguish individual intelligent. According to Siti Rahayah (2008), intelligent test is a test that attempt to measure individual differences in sensory acuity, mental diagram and individual intellectual achievement. According to Sidek (2005), there are two types of intelligences test in which it is administered as an individual test or a group test. *Stanford-Binet Intelligence Scale, Wechsler Intelligence Scale for Children* (WISC) and *Wechsler Adult Intelligence Scale* (WAIS) are among the intelligence tests that were administered individually. This type of test has high in validity and reliability.

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Although there are many individual intelligent test that have been used outside Malaysia, most of them have limitations due to the potential impact of culture, language or ethnicity, and others in which will influence the selection of gifted students (Gray, R., McCallum & Bain, 2009).

Therefore, all of these instruments are inappropriate to measure the intelligences of Malaysian students'. In order to measure the intelligence of Malaysian students, a group of researchers from Universiti Kebangsaan Malaysia has developed an instrument called UKM 2 intelligence test to overcome this problem. This instrument is based on WISC-IV and was adapted in the context of Malaysian students.

Previous studies showed that there were differences in cognitive function between male and female students. A study that was carried out by Sluis et al. (2008) found that male students obtained higher scores in the sub-test of Information and Arithmetic while female earned higher scores in the sub-test of Coding. The result was also supported by a study conducted by Lynn, Furgusson and Horwood (2005) and Lynn, Raine, Venables, Mednick and Irwing (2005) in which female obtained higher scores in the sub-test of Coding, while male score higher in the sub-test of Information, Vocabulary, Similarities, Picture Completion, Block Design, Object Assembly and Mazes.

In addition, Goldbeck, Daseking, Hellwig-Brida, Waldmann and Petermann (2010) were also conducted a study to identify the level of IQ involving 1650 respondents aged between 6 to 16 years old. This study was conducted in Germany and used the WISC-IV; German version. The findings showed that male respondents earned higher scores in the Verbal Comprehension Index (VCI) and Perceptual Reasoning Index (PRI), while female respondents earn higher scores in the Processing Speed Index (PSI). The study also showed that there was no significant difference between the two sexes in the Working Memory Index (WMI).

A study to identify the level of IQ was also conducted by Mayes and Calhoun (2008) involving 54 children who suffer from autism using WISC-IV and *Wechsler Individual Achievement Test-Second Edition* (WIAT-II). They found that the overall performance of the sub-test of Comprehension was lower than Similarities and Vocabulary. The overall performance of the respondents in the sub-test of Block Design was lower or equal to the sub-test of Picture Concepts and Matrix Reasoning. Research showed that the lowest achievement was Coding, Symbol Search, Letter and Number and Sequences and Digit Span. By using WIAT-II, they found that the overall performance of the sub-test of writing test expression was lower than other sub-test in this instrument. This study also indicated that, a child with autism has a significant strength in Perceptual reasoning Index (principal) and VCI.

In Malaysia, limitation studies in students' cognitive tendency has been made, therefore this study aimed to identify students' profile score in PRI and WMI based on gender using the UKM 2 intelligence test. This study is expected to provide an overview of the intellectual capabilities of students in Malaysia in general and specifically by gender.

2. Methodology

A quantitative approach with survey design and random sampling selection has been selected in this study. The UKM 2 intelligence test has been used in this study; an instrument that is adapted from WISC-IV. This test aimed to measure children intelligence aged from 9 to 15 years old and will be administered online. This intelligence test consists of 13 constructs with 370 open and partial credit items measuring various students' cognitive aspects in four index; VCI, PRI, WMI and PSI (Siti Fatimah, Shahrir & Noriah, 2009). This instrument has high validity and reliability items through written and computerized tests (Siti Fatimah et al., 2008). However, this study intended to investigate Malaysian students' profile scores in two index; PRI) and WM).

The PRI consists of four constructs; Block Design, Picture Concepts, Matrix Reasoning and Picture Completion (Glass, Ryan, Bartels & Morris, 2008; Largotta, 2009). These indexes measure the students' visual perception, reasoning, organizing and creating visual and non-verbal material to solve non routine problems. Block Design is a construct that assess students in problem solving, space perception and visual processing. Picture Concept is a construct that testing respondent logic or sequential reasoning and social intelligence. Matrix Reasoning is used to assess students' skills in problem solving and non-verbal abstract reasoning while Picture Completion is used to assess respondent in visual reasoning.

WMI consists of three constructs, Letter Number and Sequences, Digit Span and Arithmetic (Glass et al., 2008; Largotta, 2009). These indexes assess students' ability in working memory process and manipulation the visual or verbal sequences. Digit Span is a construct that assess students attention and concentration skills. Letter Number Sequence assesses students' skill that is related to concentrating and level of memory. The last construct is Arithmetic and it test students' mental arithmetic skills.

A total of 497 students of a Bachelor Degree in a Malaysian university were randomly selected to serve as samples of this study. Beyond that, 24.9 % were male and 75.1 % were female.

Table 1: Profile Sample

Demographic	Frequency	Percentage
Male	124	9.24
Female	373	75.1

3. Findings

Table 2 shows the mean scores obtained by the students in Perceptual Reasoning Index (PRI). Data shows that there was a significant difference between mean scores of male and female in Picture Concept ($t = -4.59$, $p < 0.05$), Matrix Reasoning ($t = -3.77$, $p < 0.05$) and Picture Completion ($t = -2.36$, $p < 0.05$).

Overall, female students earn higher mean scores in all of the constructs that have been discussed in this index. Female students obtained 98.37 of mean scores in Block Design compared to male, 97.21. Similarly in Picture Concept, the mean score for female was 55.35 compared to male, 47.26, Matrix Reasoning 46.25 while male was 31.71 and Picture Completion, female was 28.45 while male was 20.10.

Table 2: Mean scores and t-tests of the Perception Reasoning Index (PRI)'s construct

Constructs	Gender	N	Min	Standard deviation	t	Sig
Block Design	Male	124	97.21	7.36	-1.54	.126
	Female	373	98.37	7.14		
Picture Concept	Male	124	47.26	18.14	-4.59	.000
	Female	373	55.35	13.02		
Matrix Reasoning	Male	124	31.71	37.39	-3.77	.000
	Female	373	46.25	37.22		
Picture Completion	Male	124	20.10	33.32	-2.36	.019
	Female	373	28.45	36.21		

Table 3 shows the mean scores in Working Memory Index (WMI) obtained by each gender. Data shows that there was a significant difference between the mean scores of male and female in Digit Span ($t = -6.56$, $p < 0.05$), Letter Numbers and Sequence ($t = -5.15$, $p < 0.05$) and Arithmetic ($t = -3.09$, $p < 0.05$). Female students also earned higher mean scores in all of the constructs in this index compared to male. In Digit Span, female students obtained 71.46 compared to male 42.19. Similarly, in Letter Numbers and Sequence, female students obtained mean score of 34.34 compared to male, 16.10 and Arithmetic19.77 compared to male, 10.96.

Table 3:Mean scores and t-tests of the Working Memory Index (WMI)'s construct

Constructs	Gender	N	Min	Standard deviation	t	Sig
Digit Span	Male	124	42.19	44.84	-6.56	.000
	Female	373	71.46	37.22		
Letter Numbers and Sequence	Male	124	16:10	32.00	-5.15	.000
	Female	373	34.34	39.97		
Arithmetic	Male	124	10.96	25.53	-3.09	.002
	Female	373	19.77	32.74		

Table 4 shows the mean scores obtained by the students in Perceptual Reasoning Index (PRI) and Working Memory Index (WMI) based on gender. Data shows that there were significant differences between the mean scores of male and female in Perceptual Reasoning Index (PRI) ($t = -4:02$, $p < 0.05$) and Working Memory Index (WMI) ($t = -6.13$, $p < 0.05$).

In both index, female students seem to overcome male. In the Perceptual Reasoning Index (PRI), they obtained a mean score of 48.44 compared to male, 8.94. Similarly in the Working Memory index (WMI), they also overcome the male with a mean score of 36.63 while male obtained 19.68.

Table 4:Mean scores and t-tests in Perceptual Reasoning Index (PRI) and Working Memory Index (WMI)

Index	Gender	N	Min	Standard deviation	t	Sig
Perceptual Reasoning Index	Male	124	38.94	23:31	-4.02	00:00
	Female	373	48.44	22.65		
Working Memory Index	Male	124	19.68	26.11	-6.13	00:00
	Female	373	36.63	28.27		

4. Discussion

The aim of this study is to identify Malaysian students' profile scores in PRI and WMI based on their gender. Findings from this study showed that there are significant differences in mean scores of male and female students in PRI's construct; Picture Concept, Matrix Reasoning and Picture Completion whereas female earned higher scores than male. The findings of this study seem contradict with the findings mentioned by Goldbeck et al. (2010), Lynn et al. (2005a) and Lynn et al. (2005b). These researchers found that there were no significant differences between the standard scores of male and female students in all of these constructs, and male students obtained a mean standard score that was higher than females. In addition, male and female students obtained the highest scores in Block Design compared to the other constructs in this index. The result was contrary to the findings of a study by Mayes & Calhoun (2008) where their samples obtained significantly lower score in Block Design rather than Picture Concept and Matrix Reasoning. The difference in result is likely due to the different samples in their research that involving children with autism. This study also found that male and female mean scores show a declination in Picture Concept, Matrix Reasoning, and the lowest, Picture Completion.

Female students also earned higher mean scores in all of the constructs of WMI with significantly differences. The result was contrary to the study by Goldbeck et al. (2010) in which they found that there was no significant difference in mean standard scores of male and female in Digit Span and Letter Numbers and Sequence. However, this finding was supported by Lynn et al. (2005a) and Lynn et al. (2005b), in which female students score higher than male in Digit Span and Arithmetic with a non significant difference in mean scores. In addition male and female obtained the highest scores in the Digit Span, followed by Letter Numbers and Sequence and the lowest in arithmetic.

Overall, there were significant differences in mean scores of male and female students in PRI and WMI in which female students obtained higher mean scores than male. This finding was supported by Goldbeck et al. (2010) where they found that there was only small significant difference in mean standard scores of male and female students in PRI. However, the findings of this study were contradict with Goldbeck et al. (2010) in which there were no significant differences in mean standard scores between male and female students in WMI. Keith, Reynolds, Patel and Ridley (2008) also claimed that there was no significant difference between male and female in the short-term memory. The differences according to Goldbeck et al. (2010) may be due to the different in cultural influences that may effect to their education pattern.

5. Conclusion

Results showed that female students have higher intellectual ability than male in PRI and WMI. This situation shows that girls are better in making perception reasoning, organizing information, mental control and maintaining concentration. The conclusion is only limited to the selected samples in this study. The findings of this study are expected to help researchers and related parties to identify differences in intellectual ability among students specifically by gender. The researcher also suggested that a single instrument that can measure aspects of intellectual, emotional, spiritual and physical should be developed in the future to create a balanced individual as stated in the Philosophy of Education.

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